

Amendments to the claims

1 (Currently amended): A circuit to search an external memory containing search results based on a search value received from an external controller, comprising:

a hash unit ~~able~~ to generate a hash output based on the search value, wherein said hash unit is operationally connected to an input bus connecting the circuit to the external controller;

a content addressable memory (CAM) unit ~~able~~ to store a CAM database of ~~possible~~ instances of the search values known to cause hash collisions in said hash unit and ~~able~~ to match the search value against said CAM database such that a CAM output is provided if a match exists, wherein said CAM unit is also operationally connected to said input bus;

a logic unit ~~able~~ to:

receive any said CAM output provided, ~~and~~ to create an address value based there on, and to provide ~~that~~ said address value on an output bus connecting the circuit to the external memory, wherein said address value represents an address in the external memory; and otherwise

receive said hash output, ~~and to~~ create one or more hash addresses based there on, ~~to~~ receive a hash pointer value and create said address value based there on, and ~~to~~ receive a hash hit signal and responsive there to provide said address value on said output bus;

a search data storage ~~able~~ to:

store a plurality of said hash pointer values, wherein said hash pointer values represent ~~potential~~ instances of said hash addresses;

store a plurality of search data values, wherein said search data values represent ~~potential~~ instances of the search values;

receive a said hash address from said logic unit and based there on retrieve a said hash pointer value and provide it to said logic unit; and
retrieve a said search data value based on said hash pointer value; and

a comparator operationally connected to said input bus ~~and able~~ to receive the search value there from, to receive said search data value from said search data storage, to compare the search value and said search data value to determine whether a

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31 match exists and, if a said match exists, to provide said hash hit signal to said
32 logic unit, ~~thereby permitting the external memory to not store any instances of~~
33 ~~the search values.~~

1 2 (Currently amended): The circuit of claim 1, wherein said logic unit is further able to
2 generate a search hit signal based on said hash hit signal and whether a said match exists in said
3 CAM unit, and to provide said search hit signal to the external controller via a hit line, thereby
4 confirming ~~that a current instance of~~ the search result.

1 3 (Original): The circuit of claim 1, wherein said hash unit is programmable to employ
2 different hash algorithms.

1 4 (Original): The circuit of claim 3, wherein said hash unit includes a plurality of pre-
2 programmed hash algorithms, thereby permitting selectively employing a particular said hash
3 algorithm.

1 5 (Original): The circuit of claim 1, wherein said CAM unit is programmable with new entries
2 for said CAM database, from the external controller, thereby permitting the external controller to
3 program the circuit to avoid new hash collisions.

1 6 (Currently amended): A circuit for searching an external memory containing search
2 results based on a search value received from an external controller, comprising:
3 a hash means for generating a hash output based on the search value, wherein said hash
4 means is also for operationally connecting to input bus means for connecting the
5 circuit to the external controller;
6 a content addressable memory (CAM) means for storing a CAM database of ~~possible~~
7 instances of the search values known to cause hash collisions in said hash means
8 and for matching the search value against said CAM database such that a CAM
9 output is provided if a match exists, wherein said CAM means is also for
10 operationally connecting to said input bus means;

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11 a logic means for:

12 receiving any said CAM output provided, ~~and~~ creating an address value based
13 there on, and ~~for providing that~~ said address value on output bus means for
14 operationally connecting the circuit to the external memory, wherein said
15 address value represents an address in the external memory; and otherwise
16 receiving said hash output, ~~and~~ creating one or more hash addresses based there
17 on, for receiving a hash pointer value and creating said address value
18 based there on, and for receiving a hash hit signal and responsive there to
19 providing said address value on said output bus means;

20 a search data storage means for:

21 storing a plurality of said hash pointer values, wherein said hash pointer values
22 represent ~~potential~~ instances of said hash addresses;
23 storing a plurality of search data values, wherein said search data values represent
24 ~~potential~~ instances of the search values;
25 receiving a said hash address from said logic means and based there on retrieving
26 a said hash pointer value and providing it to said logic means; and
27 retrieving a said search data value based on said hash pointer value; and

28 a comparator means for operationally connecting to said input bus means and for

29 receiving the search value there from, for receiving said search data value from
30 said search data storage means, for comparing the search value and said search
31 data value to determine whether a match exists and, if a said match exists, for
32 providing said hash hit signal to said logic means, ~~thereby permitting the external~~
33 ~~memory to not store any instances of the search values.~~

1 7 (Currently amended): The circuit of claim 6, wherein said logic means is further for
2 generating a search hit signal based on said hash hit signal and whether a said match exists in
3 said CAM means, and for providing said search hit signal to the external controller via a hit line,
4 thereby confirming ~~that a current instance of~~ the search result.

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1 8 (Original): The circuit of claim 6, wherein said hash means is programmable to employ
2 different hash algorithms.

1 9 (Original): The circuit of claim 8, wherein said hash means includes a plurality of pre-
2 programmed hash algorithms, thereby permitting selectively employing a particular said hash
3 algorithm.

1 10 (Original): The circuit of claim 6, wherein said controller means is further for programming
2 said CAM means with new entries in said CAM database, thereby permitting programming to
3 avoid newly determined hash collisions.

1 11 (Currently amended): A method for searching an external memory containing search
2 results by using a search value received from an external controller, the method comprising the
3 steps of:

4 (a) generating a hash output from the search value, wherein said hash value is smaller in
5 size than the search value;

6 (b) comparing the search value against a content addressable memory (CAM) database
7 of pre-stored instances of the search value known to cause hash collisions,
8 wherein a CAM output is created if a match exists;

9 (c) creating an address value based on said CAM output if a said match exists and
10 otherwise creating said address value based on said hash output, wherein said
11 address value represents an address in the external memory; and

12 (d) providing said address value to the external memory, ~~thereby permitting finding the~~
13 ~~search results in the external memory based on the search values.~~

1 12 (Currently amended): A circuit to search an external memory containing search results
2 based on a search value received from an external controller, comprising:
3 a plurality of serially connected hash units each able to receive an input value and
4 generate a hash value based there on, wherein said input value includes all or part

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5 of the search value or a said hash value of a prior said hash unit, and wherein the
6 last said hash value is a hash output;
7 a plurality of content addressable memory (CAM) units equaling said hash units,
8 whereby each ~~respective~~ said CAM unit ~~is definable as having~~ has a paired said
9 hash unit;
10 said CAM units ~~able~~ each to store a CAM database of instances of said input values
11 known to cause hash collisions in its paired said hash unit;
12 said CAM units further ~~able~~ each to receive a said input value common with its paired
13 said hash unit, to match said input value against its said CAM database, and to
14 provide a CAM output if a match exists;
15 a logic unit ~~able~~ to receive said hash output and said CAM outputs and create an address
16 value based there on, wherein said address value represents an address in the
17 external memory; and
18 said logic unit further ~~able~~ to provide said address value on an output bus connecting the
19 circuit to the external memory, ~~thereby permitting finding the search results in the~~
20 ~~external memory.~~

1 13 (Original): The circuit of claim 12, wherein said hash unit is programmable to employ
2 different hash algorithms.

1 14 (Original): The circuit of claim 13, wherein said hash unit includes a plurality of pre-
2 programmed hash algorithms, thereby permitting selectively employing a particular said hash
3 algorithm.

1 15 (Original): The circuit of claim 12, wherein said CAM unit is programmable with new entries
2 for said CAM database, from the external controller, thereby permitting the external controller to
3 program the circuit to avoid new hash collisions.

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1 16 (Currently amended): The circuit of claim 12, further comprising:
2 a plurality of hash input logics, one per said hash unit, to selectively ~~able to~~ route said
3 input values to their respective said hash units and to said CAM units;
4 a CAM input logic ~~able~~ to selectively route said input values to said plurality of CAM
5 units; and
6 a CAM output logic ~~able~~ to selectively combine said CAM outputs, thereby permitting
7 configurable application of said pluralities of said hash units and said CAM units.

1 17 (Currently amended): The circuit of claim 12, wherein said logic unit is further ~~able~~ to
2 create one or more hash addresses based on said hash output and an offset value, and ~~to~~
3 ~~additionally permit creating~~ create said address value based on a pointer value and a hash hit
4 signal, and the circuit further comprising:
5 a search data storage ~~able~~ to store a plurality of hash pointer values and a plurality of
6 search data values, wherein said hash pointer values represent ~~potential~~ instances
7 of said hash outputs and said search data values represent ~~potential~~ instances of
8 said search values;
9 said search data storage further ~~able~~ to receive said hash address from said logic unit, to
10 retrieve a said hash pointer value based on said hash address, to provide said hash
11 pointer value to said logic unit as said pointer value, and to retrieve a said search
12 data value based on said hash pointer value; and
13 a comparator operationally connected to said input bus, said comparator ~~able~~ to receive
14 the search value from said input bus, to receive said search data value from said
15 search data storage, to compare the search value and said search data value to
16 determine whether a match exists, and, if a said match exists, to provide said hash
17 hit signal to said logic unit, ~~thereby permitting the external memory to not store~~
18 ~~any instances of the search values.~~

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1 18 (Currently amended): The circuit of claim 17, wherein said logic unit is further ~~able~~ to
2 generate a search hit signal based on said hash hit signal and whether a said match exists in said
3 CAM unit, and to provide said search hit signal to the external controller via a hit line, thereby
4 confirming ~~that a current instance of~~ the search result.

1 19 (Currently amended): The circuit of claim 17, further comprising:
2 a plurality of hash input logics, one per said hash unit, to selectively ~~able to~~ route said
3 input values to their respective said hash units and to said CAM units;
4 a CAM input logic ~~able~~ to selectively route said input values to said plurality of CAM
5 units; and
6 a CAM output logic ~~able~~ to selectively combine said CAM outputs, thereby permitting
7 configurable application of said pluralities of said hash units and said CAM units.

1 20 (Currently amended): A circuit for searching an external memory containing search
2 results based on a search value received from an external controller, comprising:
3 a plurality of serially connected hash means for each receiving an input value and
4 generating a hash value based there on, wherein the first said hash means
5 operationally connects to input bus means for connecting the circuit to the
6 external controller and wherein said input value includes all or part of the search
7 value or a said hash value of a prior said hash unit, and wherein the last said hash
8 value is a hash output;
9 a plurality of content addressable memory (CAM) means, equaling said hash means,
10 whereby each respective said CAM means is definable as having a paired said
11 hash mean;
12 said CAM means for storing a CAM database of instances of said input values known to
13 cause hash collisions in its paired said hash means;
14 said CAM means further for receiving a said input value common with its paired said
15 hash means, for matching said input value against its said CAM database, and for
16 providing a CAM output if a match exists;
17 a logic means for receiving said hash output and said CAM outputs and for creating an

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18 address value based there on, wherein said address value represents an address in
19 the external memory; and
20 said logic means further for providing said address value on output bus means for
21 connecting the circuit to the external memory, thereby permitting finding the
22 search results in the external memory.

1 21 (Original): The circuit of claim 20, wherein said hash means is programmable to employ
2 different hash algorithms.

1 22 (Original): The circuit of claim 21, wherein said hash means includes a plurality of pre-
2 programmed hash algorithms, thereby permitting selectively employing a particular said hash
3 algorithm.

1 23 (Original): The circuit of claim 20, wherein said controller means is further for programming
2 said CAM means with new entries in said CAM database, thereby permitting programming to
3 avoid newly determined hash collisions.

1 24 (Original): The circuit of claim 20, further comprising:
2 a plurality of hash input logic means, one per said hash means, for selectively routing
3 said input values to their respective said hash means and to said CAM means;
4 CAM input logic means for selectively routing said input values to said plurality of CAM
5 means; and
6 CAM output logic means for selectively combining said CAM outputs, thereby
7 permitting configurable application of said pluralities of said hash means and said
8 CAM means.

1 25 (Currently amended): The circuit of claim 20, wherein said logic means is further for
2 creating one or more hash addresses based on said hash output and an offset value, and for
3 additionally permitting creating said address value based on a pointer value and a hash hit signal,
4 and the circuit further comprising:

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5 search data storage means for storing a plurality of hash pointer values and a plurality of
6 search data values, wherein said hash pointer values represent ~~potential~~ instances
7 of said hash outputs and said search data values represent ~~potential~~ instances of
8 said search values;

9 said search data storage means further for receiving said hash address from said logic
10 means, for retrieving a said hash pointer value based on said hash address, for
11 providing said hash pointer value to said logic means as said pointer value, and
12 for retrieving a said search data value based on said hash pointer value; and

13 said comparator means for operationally connecting to said input bus means, for
14 receiving the search value from said input bus means, for receiving said search
15 data value from said search data storage means, for comparing the search value
16 and said search data value to determine whether a match exists, and, if a said
17 match exists, for providing said hash hit signal to said logic means, thereby
18 permitting the external memory to not store any instances of the search values.

1 26 (Original): The circuit of claim 25, wherein said logic means is further for generating a
2 search hit signal based on said hash hit signal and whether a said match exists in said CAM
3 means, and to provide said search hit signal to the external controller via a hit line, thereby
4 confirming that a current instance of the search result.

1 27 (Original): The circuit of claim 25, further comprising:

2 a plurality of hash input logic means, one per said hash means, for selectively routing
3 said input values to their respective said hash means and to said CAM means;
4 CAM input logic means for selectively routing said input values to said plurality of CAM
5 means; and

6 CAM output logic means for selectively combining said CAM outputs, thereby
7 permitting configurable application of said pluralities of said hash means and said
8 CAM means.

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28 (Currently amended): A method for searching an external memory containing search results based on a search value received from an external controller, the method comprising the steps of:

- (a) generating a plurality of hash outputs based on respective input values having decreasing order, wherein said input values include all or part of the search value or a said input value of just higher order;
- (b) comparing said respective input values against a like number of respective content addressable memory (CAM) databases such that respective CAM outputs are created if respective matches exist, wherein said respective CAM databases include pre-stored instances of said input values known to cause hash collisions;
- (c) creating an address value based on said CAM output produced responsive to the highest order said input value producing a said match, if any, and otherwise creating said address value based on the last said hash output, wherein said address value represents an address in the external memory; and
- (d) providing said address value to the external memory, thereby permitting finding the search results in the external memory based on the search values.